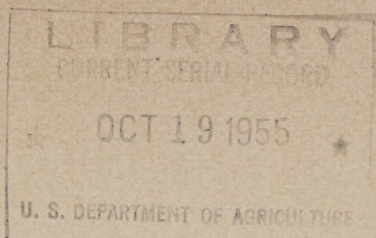


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## The Saratoga Spittlebug

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The Saratoga spittlebug (*Aphrophora saratogensis* (Fitch)), so-called because it was first collected in Saratoga County, N. Y., is a native insect, originally described over 100 years ago. In eastern North America it is distributed from Nova Scotia west through southern Canada and northern United States to Minnesota, and from Ontario south along the Appalachian Mountains to Florida. In western North America it has been recorded in British Columbia and California.

The insect's association with pines has been known for many years, but until recently it was not recognized as injurious to young trees. Damage of serious proportions was first observed by H. C. Secrest in red and jack pine plantations on the Manistee National Forest, Mich., in 1941. Since then, the insect has completely wiped out the pine in many areas of 10 acres or less in the Lake States (fig. 1). Since 1946 over 60,000 acres of plantations in Michigan and Wisconsin have required spraying to curb the ravages of this insect.

### Hosts

Red pine is the preferred adult host; jack pine ranks next. White pine is frequently attacked but seldom is severely injured. Adult insects have been collected also from pitch pine, tamarack, balsam fir, and white spruce.

Hosts of the nymphs include more than 40 species of herbs and shrubs. Everlasting, aster, and ragwort are herbaceous plants commonly attacked by the early instars; the later instars prefer woody plants, particularly sweetfern, brambles, prairie willow, and aspen sprouts.

### Symptoms of Damage

Damage is usually limited to trees between 2 and 12 feet in height, although larger trees are attacked. Symptoms of injury are: (1) Reddish-brown "flags" (dead foliage) in part or all of the crown in spring; (2) numerous tiny punctures on the twigs (fig. 2, *D*), most abundant on 1-year-old growth, and often covered with minute droplets of resin; and (3) light tan flecks in the wood and inner bark at points where the punctures occur (fig. 2, *E*). Severely injured twigs contain dead areas which are sometimes dark in appearance and usually infiltrated with resin. These symptoms are caused by the feeding of the adults on the twigs, and by the pathogenic action of the burn blight fungus (*Chilonectria cucurbitula* (Curr.) Sacc.), which may enter through the feeding punctures. Death of the affected parts results from the threefold action of sap withdrawal by the insect, mechanical blocking of conducting tissue by resin infiltration around the punctures, and invasion of the cortex and outer cells of the wood by the





Figure 1.—Jack pine killed by the Saratoga spittlebug.

fungus. The foliage usually drops from the injured parts of the crown within a year to a year and a half after fading.

### Description of the Insect

The adult is winged and its length is about 1 centimeter. It ranges in color from light brown to tan with oblique, wavy markings on the wing covers, and usually a light, irregular stripe on the head and pronotum. The egg is about 0.5 millimeter in diameter by 2 millimeters in length, and pale yellow to purple in color. The nymphs vary in length from 2 millimeters, upon emerging from the eggs to 8 millimeters just before transforming into adults. In the first four instars the most striking characteristic is the color of the abdomen, which is scarlet, bordered by black at the sides, contrasting sharply with the dark head and thorax. The fifth and last instar is dark brown throughout.

### Life Cycle

The adults are active from about the end of June to late September (fig. 2, *A*). Most of them appear during the second and third weeks of July, and transformation is usually completed by early August. Feeding begins almost immediately and continues during the period of adult activity. Mating takes place within 2 weeks, and egg-laying about 3 weeks after emergence. The adults are strong fliers, darting from the foliage in a characteristic manner when disturbed.

The eggs are laid during the early evening hours when favorable temperatures ( $65^{\circ}$  to  $80^{\circ}$  F.) prevail (fig. 2, *B*). The eggs are never placed inside living plant tissue. On red pine they are usually inserted between the scales of living terminal buds and in the sheaths of needles nearby. This causes a characteristic swelling in the scales. On jack pine, eggs are laid only in dead buds where the resin has been





Figure 2.—Saratoga spittlebug: A, Adult on pine needles; B, eggs inserted between scales of red pine bud; C, spittlemass formed by nymphs at base of sweetfern; D, scars from adult feeding-punctures on pine twigs; E, cross sections of pine twigs showing scar tissue in early growth layers from spittlebug attacks.

worn away, and in the sheaths of the current year's needles; eggs are sometimes found under the loose bark of dead jack pine twigs. Occasionally eggs are laid in the terminal buds of northern red oak and red maple, and in crevices beneath the bark of broken or dead twigs in such species as wild cherry, willow, blackberry, sumac, and elder.

The Saratoga spittlebug overwinters in the egg stage. The nymphs appear early in May, about the time the buds of jack and red pines begin to elongate. They conceal themselves beneath the surface of the litter in spittle masses formed on the root collars of suitable host plants (fig. 2, C), most commonly in the vicinity of pines. Six to eight weeks are required for nymphal development, there being 5 instars that vary

from 5 to 14 days each in duration. Although the young nymphs are found on a large number of herbaceous plants, they migrate to woody hosts during the fourth and fifth instars. An average of 1 nymph per plant during these later instars, where the density of nymphal host plants is greater than 1 per square foot of ground, is usually associated with severe damage to pine.

### Natural Control

Low temperatures greatly restrict the activities of the adults. Below 60° F. egg-laying is sharply curtailed, and at 50° F. feeding and mating cease. There is no evidence that the eggs are affected by the subzero temperatures normally occurring in northern Michigan and Wisconsin. The nymphs are susceptible to subfreezing weather;



but probably very severe "freezes" are required to appreciably affect this stage, since the temperature beneath the litter remains high enough to protect the insect unless the air temperature falls below 22° F. Prolonged cold weather, severe enough to kill the less hardy hosts, undoubtedly delays development of the nymphs and kills an appreciable number of them.

Biotic enemies of the spittlebug are comparatively few and do not appear to be of great importance in keeping the insect in check. The adults are attacked by entomogenous fungi of the genus *Beauveria* and by parasitic flies (family *Dorilaidae*). Two tiny wasps (*Ooetonus aphrophorae* Milliron and *Tumidiscapus cercopiphagus* Milliron) are parasites of the eggs. Ants and birds feed on exposed nymphs. No other enemies of this stage are known.

### Indirect Control

In selecting sites for red or jack pine plantations, the hazard of spittlebug attack should be weighed before the trees are established. Areas that are relatively free of host plants favored by the nymphs should be chosen in preference to sites where such plants abound. Otherwise, dense planting is advisable to secure crown closure at an early age, in order to shade out the nymphal hosts as quickly as possible.

### Chemical Control

The most satisfactory direct method developed thus far to combat the spittlebug in forest planta-

tions is by airplane application of DDT spray to control the adults. In accessible areas applications of this chemical by mist blowers have met with some success. In small areas of infestation, knapsack sprayers producing a very fine mist have been effective. For airplane spraying the treatment recommended is 1 pound of technical DDT in 1¼ quarts of auxiliary solvent (Sovicide PB544C or equal) per gallon of No. 2 fuel oil per acre. For mist blowers or knapsack sprayers the quantity of fuel oil should be doubled and the rate of application increased to 2 gallons per acre. In order to minimize current damage and kill the females before the eggs are laid, spraying should begin as soon as the majority of the adults appear (usually during the second or third week in July), and should be completed within 2 or 3 weeks. Where the hazard of reinfestation is not serious, a single properly timed spraying should provide protection for three or more years.

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